other States asked that their universities should also be admitted to the foundation. The fact that only five State institutions, one of these in Canada, have been admitted to the Carnegie Foundation, after a year of administration of the rules under which tax-supported colleges and universities became eligible, testifies to the scrutiny exercised in the admission of institutions. There are now sixty-seven institutions on the accepted list.

The second section of the report is devoted to an examination of the working of the rules for retirement, as shown in the experience of the past four years. As a result of the experience, two changes were made in the rules by the trustees; one extends the benefits of the retiring allowance system so that service as an instructor shall count toward the earning of a retiring allowance. Heretofore only service in the rank of professor was counted toward an allowance. The other change makes retirement after twenty-five years of service possible only in the case of disability unfitting the teacher for active service. Except in the case of such disability, the teacher can, under the rules as now framed, claim a retiring allowance only upon attaining the age of sixty-five. Formerly a professor might retire after twenty-five years of service. This change in the rules does not, however, deprive the widow of a teacher who has had twenty-five years of service of her pension.

The third section of the report is devoted to tax-supported institutions. Agricultural education and the agricultural college are also treated at length. The trustees make clear their intention to ask of the institutions of every State whether the university and the college of agriculture are competing or cooperating parts of a State system of education. The low standards and general demoralisation resulting from the competition of these two types of tax-supported institutions in the various States are pointed out. In the fourth section of the report it is said to be noteworthy that only a small proportion of the colleges and universities calling on the public for support print a straightforward financial statement showing what they do with the money collected from the public. Following the report of the president is the report of the treasurer. In this matter the foundation has followed the advice which it gives to other institutions, and prints a detailed statement, showing, not only the larger items of expense, but even the individual salaries which are paid.

BOSTON MEETING OF THE AMERICAN ASSOCIATION.

EXTRACTS FROM THE ADDRESSES OF SECTIONAL PRESIDENTS.

The Teaching of Physics.

In his address to Section B (Physics), Prof. K. E. Guthe discussed reforms needed in the teaching of physics. He maintained that the decision as to how physics should be taught rests finally with those men who know the subject, understand the spirit of the science, and for this reason are the only judges of its characteristic educational value. Concerning himself particularly with the teaching of physics in American colleges and universities, he proposed two questions, "May not the preparation which professors give future teachers be faulty?" and "May not the professors teaching be capable of improvement?" He said he believed both these questions should be answered in the affirmative. The system of the teaching of physics in many American colleges and universities is, he maintained, more adapted to train professional physicists than future high-school teachers. The two should receive a different training. The ideal high-school teacher is one who has passed through a complete and thorough graduate course. At the present time the great majority of American high-school teachers do not go beyond graduation, and Prof. Guthe would deplore any attempt to crowd so much physics into the undergraduate course that the physicist finally turned out lacks the general culture which an undergraduate course should give. American professors of physics should, he insisted, emphasise more problem work in connection with the elementary course. An utter helplessness of many higher classmen in attacking elementary problems is not unusual. The laboratory work given with the elementary course is frequently quite insufficient, and a somewhat advanced course, not in special lines, but covering the whole field, will do an untold amount of good. Finally, there should be a general review of the whole subject from a higher point of view than is possible in the elementary course. The calculus might be a required study for this. At this point subjects might be taken up which have been omitted in the first course; the treatment could be more thorough and more exact. The introduction of such an advanced course would also have a good influence upon the first course. Prof. Guthe advised future teachers of physics to take also a course in meteorology, a short course in dynamo-electric machinery, and an elementary course in instrument-making, all of which might properly be given in the physics department. Such a graded course will produce, he thinks, teachers to whom may be left without hesitancy the question as to how physics should be taught in the high school. The second proposition considered was, "Professors of physics are far from being unanimous in the use of certain terms, and frequently employ the same term to designate two entirely different physical quantities." This means that enough attention is not paid to the very things which make physics so valuable as a training of the mind, namely, clearness of thinking and accuracy of expression. Prof. Guthe cited and considered numerous cases in point, among them being the terms used in connection with pressure, surface tension, measurement of quantities of heat, and fields of magnetic force.

The Study of Solutions.

Prof Louis Kahlenberg, of the University of Wisconsin, presided over Section C (Chemistry), and in his address dealt with the past and future of the study of solutions.

The study of solutions, he said, was begun with the chemical conception of solutions, and upon this conception many relationships were worked out during the first eighty-seven years of the nineteenth century. The older chemists clearly recognised that whether solution will take place or not in a given case is first of all determined by the chemical nature of the substances brought into contact with each other. They saw that the temperature factor was next in importance, and that pressure was of vital consequence when a gas was under consideration, but of slight importance in the case of solids and liquids. When the conception that solutions are mere physical mixtures came to the foreground, through the introduction of gas analogies and the intense propagandism of the dilute school, the fact that the act of solution is really chemical in character was lost sight of by many able, enthusiastic young investigators. In the ardour of their quest they were misled, and unwittingly they naturally misled others. It is really pitiable to see how physiologists, having thus taken up these misconceptions of the nature of solutions, are still wasting precious time in endeavouring to work out the complicated and very important processes that occur in living plants and animals. In these problems, which are in reality perhaps the very greatest that confront us at the present day, theories of solutions based on gas analogies are of no avail. They are thoroughly misleading and worse than worthless here.

The clear recognition that solutions are really chemical in character, and that there is no wide gulf that separates the act of solution from other chemical phenomena, will do much toward furthering the future study of the subject. Years of experimental study of the chemical, physical, and physiological properties of a long list of both aqueous and non-aqueous solutions have led to the conviction that the act of solution is chemical, that solutions are chemical combinations, and that we can only make real progress toward a better understanding of the various solutions by recognising this as the basis of all our future work. The efforts to gain a better insight into the different solutions that confront us must be chiefly experimental, rather than mathematical; for in the study of solutions, just as in the study of chemical compounds in the narrower sense of the word, we are continually confronted with discontinuities. Now discontinuous functions cannot be handled mathematically at present not even by the greatest of our mathematicians, for though work of this kind has been begun, it is still in a very rudimentary stage. It is highly probable, too, that the renewed study of solutions from the chemical point of view will greatly aid us in getting a broader and more correct conception of the nature of chemical action itself. Certainly in living beings we have numerous, fundamental, and deep-seated chemical changes going on continually with apparently the greatest ease at ordinary temperatures and pressures, and it is tantalising that we are unable to comprehend how this is all brought about. In the unravelling of the questions that here confront us a clear recognition that solutions are chemical in nature will be of the greatest service.

Engineering as a Profession.

Prof. G. F. Swain, of Harvard University, addressed Section D (Mechanical Science and Engineering) on engineering as a profession. During the course of his remarks he said:—

The field of engineering is more extensive than that of any of the three so-called learned professions, and the different branches of the profession differ from each other to such an extent as in some cases to have little in common, except a knowledge of the general principles of physics, chemistry, mechanics, and other sciences. The profession of the physician, it is true, is divided into many specialities, but while the throat specialist deals with the throat, and the stomach specialist with the stomach, they are all dealing with the human body, in which all the parts and functions are closely interconnected; but even within the field of what is termed civil engineering, the railroad engineer and the irrigation engineer, or the railroad engineer and the architectural engineer, have little in common.

The work of the engineer as applied to any contemplated project consists essentially of four parts, first, to ascertain whether anything should be done, and, if so, what should be done; second, to design and formulate the means to be employed in doing it; third, to select the proper materials; and, fourth, to carry on the actual work into execution. As the engineer's problem is to adapt the materials, the forces, the sources of power in nature to the use and convenience of man, it is clear that in order to fulfil his calling to the highest extent the engineer should be scientifically trained—that he should be familiar with the fundamental principles which govern natural phenomena. Different branches of science are required in varying degrees in the different branches of the profession, but every engineer should know, and know thoroughly, the fundamental principles of chemistry, physics, mathematics, and mechanics. The engineer should be possessed of the true scientific spirit, loving the study of science for its own sake as well as for its applications, and trained to seek always the truth, the whole truth, and nothing but the truth; but the work of the engineer deals, not with science for its own sake, but with its applications to the practical affairs of men. The engineer must, therefore, be above all a *practical man.* He must not be a pure theorist, a dreamer, a visionary. He must see in his mathematical formulæ a meaning, and not a simple accumulation of letters. The engineer, then, must not only be a scientific man, but he must be, first and foremost, a practical man; and, on the whole, the latter is more important than the former, although it is in the proper combination of the two that the greatest excellence will result.

The engineer, unlike the true man of science or mathematician, does not work in his laboratory or his study—his work is with the affairs of men. Engineering is more than half business, and the successful engineer, therefore, must be to a considerable extent a *business man* and a *financier.*

The profession of the engineer is a wide and varied one, but it requires varied qualifications, and demands pre-eminently an all-round man. It must not be forgotten, however, that without the scientific training, or at least the scientific spirit, the engineer will not attain the highest success. It is also evident that the thoroughly trained and capable engineer will find many opportunities to make himself useful in scientific as well as in administrative positions. He will also find many opportunities for doing general public service to the State or nation. Different men have different ideals of success, but the highest ideal is the one which most involves the idea of public service.

The Principles of Palaeogeography.

In his presidential address to Section E (Geology and Geography), Prof. Bailey Willis, of the University of Chicago, discussed the principles of palæogeography. To summarise his remarks, it may be said that the following were given as the fundamental principles of the science:—

Ocean basins are permanent hollows of the earth's surface, and have occupied their present sites since an early date in the development of geographical features. This principle does not exclude notable changes in the positions of their margins, which have encroached upon continental areas.

Superficial oceanic circulation within the permanent oceans has persisted since an early stage of their existence, essentially in the great drifts which it now follows under the trade winds. It is probable that the present deep circulation of oceanic waters, poleward at the surface and equatorward below the surface, is due to exceptional refrigeration at the pole.

Diastrophism has been periodic. Viewed according to the periodicity of diastrophism, the earth's history falls into cycles, and each cycle into two periods, one of inactivity and another of activity. The periods of inactivity have been long, and during a major part of the duration of any such period the condition of inactivity has been common to the entire surface of the globe. The periods of diastrophic activity have been relatively short, and, as regards the whole surface of the earth in general, not contemporaneous. The great ocean basins are distinct dynamic provinces, and each has experienced periods of diastrophic activity peculiar to its individual history. The epochs of organic deformation are relatively brief. Folding and unconformity are frequently not contemporaneous even in one and the same dynamic province.

The processes of erosion, sedimentation, chemical activity and organic evolution have been periodically conditioned according to the periodicity of diastrophism. The corresponding physical phenomena exhibit rhythmic changes which repeat similar conditions in like associations.

Erosion has been constant on land surfaces through the activity of some of the subprocesses, decay, denudation, or aggradation, which have never failed to make a record.

Marine sedimentation has sometimes been inconstant. During periods of diastrophic activity, when lands have been high, epicontinental seas small, and marine currents largely confined within deep ocean basins, sedimentation has been dominant; but during periods of diastrophic inactivity, when lands have been low, epicontinental seas extensive, and marine currents active on shallows and straits, sedimentation has failed in consequence of non-deposition or marine scour in appropriate situations.

The criteria of correlation are both physical and organic. The physical facts are basal. The organic forms, though endowed with evolutionary energy, are dependent and sequential.

Evolution of Intelligence.

Prof. C. Judson Herrick in his presidential address to Section F (Zoology) discussed the evolution of intelligence and its organs. In the course of his address he observed:—

Many a boy's brains are curdled and squeezed into traditional artificial moulds before he leaves school. His education is complete, and senile sclerosis of the mind has begun by the time he has learned his trade. For how many such disasters our brick-yard methods in the public schools are responsible is a question of lively interest. We who seek to enter into the kingdom of knowledge and to continue to advance therein must not only become as little children, but we must learn to *continue so.* The problem of scientific pedagogy is essentially this—to prolong the plasticity of childhood, or otherwise expressed, to reduce the interval between the first childhood and the second childhood to as small dimensions as possible. The docile or educational period of a mammal is largely devoted to the progressive mechanisation of the in-born plastic tissue of the higher correlation centres, *i.e.* to habit formation, or otherwise expressed, to the elaboration of acquired automatisms and reflexes of the type commonly referred to as lapsed intelligence. Much confusion has arisen from the failure to distinguish these individually acquired automatisms from those performed in the hereditary pattern, *i.e.* lapsed intelligence from true instinct.

Summarising the argument of his address, Prof. Herrick said:—In our analysis of the behaviour of animals and its mechanisms we start with the tropism and the reflex. This type of response is in some of its simpler phases indistinguishable from the reactions of dead machines to the forces which actuate them; but the more complex reflexes, on the other hand, grade over into those behaviour types which we call intelligent. No one has yet succeeded in formulating a clear-cut definition of the limits of the reflex at either its lower or its higher extreme, and perhaps no one ever will, for the whole list of behaviour types from machines to men probably forms a closely graded series.

Even the simpler reflexes exhibit a measurable refractory phase or pause in the centre where the afferent impulse is made over into the efferent. When reflexes are compounded, there is another factor which may tend to modify or delay the response. This is the dilemma which arises when two or more reflex centres are so related that a given afferent impulse coming to one of them may take any one of several final common paths to the organs of response. The reflex response which actually emerges in such a case will generally be the adaptive one, *i.e.* the one which is best for the organism. The selection of the adaptive response in such a case may be termed *physiological choice*, and it always involves a lengthening of the refractory phase. In the neural tensions of the refractory phase of physiological choice we find the germs of the complex anticipatory reactions which in turn have nurtured the awakening intelligence.

The comparative study of animal behaviour in the broadest sense of the term is as essential as other branches of physiology to the comprehension of animal structures, and the enlargement of our knowledge of scientific fact in this field will contribute greatly to the more perfect integration of the three great branches of biology—anatomy, physiology, and psychology—and the correlation of the whole with other departments of knowledge. Our philosophy of nature is sound just in proportion as we succeed in effecting these correlations of experience.

Response to Chemical Stimulation.

In Section G (Botany) the president, Prof. H. M. Richards, of Columbia University, New York, addressed the members on the nature of response to chemical stimulation. Few, if any, physiologists would, he said, to-day be inclined to deny the ultimate chemical nature of the response of protoplasm to any form of stimulus. It is the purpose here to limit the examination of chemical irritation more especially to actual concrete chemical substances brought into relation with living protoplasm, and to inquire somewhat more particularly into their mode of action and the nature of the changes which they induce. The importance and fundamental nature of these reactions cannot be doubted. For this purpose we may include in the list all those substances which it may reasonably be believed induce, by that chemical action, constitutional changes in protoplasm. These substances may be mineral salts, organic compounds of great diversity of structure, including anæsthetics, which have been, perhaps, wrongly placed in a special class, and even gases of a simple constitution. They may be crystalloidal, electrolytes or non-electrolytes, or perhaps even colloidal.

There are some points in regard to the normal food supply which have a direct bearing upon the question of chemical stimulation, as defined even in its restricted sense. In the case of some of the necessary food materials the concentration may vary within relatively wide limits before the effects of a lack or excess of these substances are observable. In such cases the increase necessary to produce a reaction may readily be so great as to involve a material increment in the isotonic coefficient of the solution, and thus confuse any result produced by any direct chemical stimulus with those initiated by the change in osmotic pressure. It is known, however, that some of the necessary salts which are required by the plant in relatively small quantities may, if the concentration be raised above the normal point, cause a secondary stimulation of growth, and eventually, if the increase be continued, become inhibitory after the manner of poisons.

In its restricted sense, chemical stimulation may be said to deal with the effects of chemical agents which are not only not necessary, but which may be positively deleterious to the organism—poisons, in short. It has been established that many, if not all, classes of substances which exert a toxic action on protoplasm will become stimulatory if presented to the cells in sufficiently small doses. Somewhere between an infinitesimally weak solution which produces no reaction to the toxic dose which kills there is a stimulative optimum which gives the maximum of reaction. The question is not the possible ultimate lethal effect of these poisons, but how far they may serve to excite the protoplasm to extraordinary activity. The amount required to effect the latter result will naturally vary with the substance, certain mild poisons possibly never affecting the plant beyond the stage of stimulating growth, no matter how high a concentration was employed.

Prof. Richards concluded by dealing in some detail with the influence of chemical stimulus on the physiological activities of the plant, and why and in what manner the specific irritants used affect the quantitative, and even perhaps the qualitative, formation of enzymes.

Racial Differences in Mental Traits.

In Section H (Anthropology and Psychology) Prof. R. S. Woodworth, of Columbia University, the president of the section, in his address took up the question of racial differences in mental traits.

Our inveterate love for types and sharp distinctions, he said, is apt to stay with us even after we have become scientific, and vitiate our use of statistics to such an extent that the average becomes a stumbling-block rather than an aid to knowledge. We desire, for example, to compare the brain weights of whites and of negroes. We weigh the brains of a sufficient number of each race—or let us, at least, assume the number to be sufficient. When our measurements are all obtained and spread before us, they convey to the unaided eye no clear idea of a racial difference, so much do they overlap. If they should become jumbled together, we should never be able to separate the negroes from the whites by aid of brain weight; but now we cast up the average of each group and find them to differ, and though the difference is small, we straightway seize on it as the important result, and announce that the negro has a smaller brain than the white. We go a step further, and class the white as a large-brained race, the negro as a small-brained. Such transforming of differences of degree into differences of kind, and making antitheses between overlapping groups, partakes not a little of the ludicrous.

We seem to be confronted by a dilemma; for the group, as a whole, is too unwieldy to grasp, while the average, though convenient, is treacherous. What we should like is some picture or measure of the *distribution* of a given trait throughout the members of a group; and, fortunately, such measures and pictures can be had. Convenient and compact measures of variability are afforded by the science of statistics, and are of no less importance than the average; but still better, because closer to the actual facts, are graphic or tabular pictures of the distribution of the trait, showing the frequency with which it occurs in each degree. The distribution of a trait is for some purposes more important than the average.

After considering certain precautions and criticisms, Prof. Woodworth dealt in order with the various senses. The point of special interest is, he pointed out, as to whether the statements of many travellers, ascribing to the "savage" extraordinary powers of vision, hearing, and smell, can be substantiated by exact tests. The common opinion, based on such reports, is, or has been, that savages are gifted with sensory powers quite beyond anything of which the European is capable, though Spencer explains that this is a cause of inferiority rather than the reverse, because the savage is thus led to rely wholly on his keen senses, and to devote his whole attention to sense impressions, to the neglect and atrophy of his intellectual powers.

Sight, hearing, smell, touch, the pain sense were each considered in detail, and Prof. Woodworth came to the conclusion that, on the whole, the keenness of the senses seems to be about on a par in the various races of mankind. Differences exist among the members of any race, and it is not improbable that differences exist between the averages of certain groups, especially when these are small, isolated, and much inbred. Some interest, said

Prof. Woodworth later, attaches to tests of the speed of simple mental and motor performances, since, though the mental process is very simple, some indication may be afforded of the speed of brain action. The reaction time test has been measured on representatives of a few races, with the general result that the time consumed is about the same in widely different groups.

Chemical Regulation of the Processes of the Body.

Prof. W. H. Howell, of the Johns Hopkins University, delivered the presidential address in Section K (Physiology and Experimental Medicine). He summarised the present state of knowledge of the chemical regulation of the processes of the body by means of activators, kinases, and hormones. The chief points touched upon are as given in the following brief abstract.

In recent years we have come to understand that the complex of activities in the animal body is united into a functional harmony, not only through a reflex control exerted by the nervous system, but also by means of a chemical regulation effected through the blood or other liquids of the organism. Having referred to Brown-Séquard's generalisation, according to which every tissue of the body in the course of its normal metabolism furnishes material to the blood that is of importance in regulating the activities of other tissues, Prof. Howell said in recent years it has been re-stated in attractive form by Schiefferdecker in his theory of the symbiotic relationship of the tissues of the body. According to this author, we may conceive that among the tissues of a single organism the principle of a struggle for existence, which is so important as regards the relations of one organism to another, is replaced for the most part by a kind of symbiosis, such that the products of metabolism in one tissue serve as a stimulus to the activities of other tissues. From many sides and in many ways facts have been accumulating which tend to impress the general truth that the co-activity of the organs and tissues may be controlled through chemical changes in the liquid media of the body as well as through nerve impulses, but in physiology, at least, we owe the definite formulation of this point of view to Bayliss and Starling. Starling's convenient term of "hormone" as a general designation for such substances has served to give a wide currency to the conception.

In treating this subject one must consider also the more or less nearly related instances of combined activity of a chemical sort which are expressed by such terms as chemical activators, kinases, and co-ferments. These terms, like that of hormone, are relatively new; they have been brought into existence by investigators to explain or to express special reactions connected with metabolism, and particularly with the action of ferments. The word activator has reference to the fact, long known, that the ferments, or some of them at least, are secreted in an inactive form, a proferment, which is activated or converted to an active form by a reaction with some definite substance produced elsewhere in the body.

The term kinase is used at present in animal physiology in connection with two reactions only. In both cases it refers to an activating process where the activator is a colloidal substance of unknown composition.

In addition to the activators of the inorganic and the colloidal type, there is perhaps a third kind of activation exemplified in the substances known as co-enzymes or co-ferments. This term may be used to define that kind of cooperative activity between an enzyme and some other non-colloidal substance which we see illustrated in the influence of the bile salts upon pancreatic lipase. The process differs from activation of a proferment to a ferment only in that the combination of the enzyme with its activator is dissociable instead of being permanent. By dialysis or otherwise the co-enzyme can be separated from the enzyme, and the action of the two may be tested separately or in combination. Starling defines hormones as chemical messengers which, formed in one organ, travel in the blood stream to other organs of the body and effect correlation between the activities of the organ of origin and the organs on which they exert their specific effect. Such substances belong to the crystalloid rather than the colloid class; they therefore are thermostable, and do not act as antigens when injected into the living animal.

The substances of known composition which may be regarded as playing the *rôle* of hormones are few in number, three or four at most, as follows:—first, the carbon-dioxide formed in the tissues, particularly in muscle during contraction; secondly, the adrenalin of the adrenal glands, which in some way, directly or indirectly, makes possible the full functional activity of the involuntary musculature of the body; thirdly, the hydrochloric acid produced in the stomach, which stimulates the formation of secretin in the duodenal epithelium; and, fourthly, possibly the iodothyrin of the thyroid gland, with its dynamogenic effect upon the neuro-muscular apparatus of the body. In addition, there are a number of hormones of unknown composition which have been either proved or assumed to exist, and are held responsible for certain well-known correlations of function.

Method and Matter of Science.

Under the title "Science as Subject-matter and as Method," Prof. John Dewey, of Columbia University, in his presidential address to Section L (Education), introduced the question of how far the science teaching in schools has up to the present been educational in the true sense.

All, he said, who are much interested in securing for the sciences the place that belongs to them in education feel a certain amount of disappointment at the results hitherto attained. The glowing predictions made respecting them have been somewhat chilled by the event. Of course, this relative shortcoming is due in part to the unwillingness of the custodians of educational traditions and ideals to give scientific studies a fair show. Yet in view of the relatively equal opportunity accorded to science to-day compared with its status two generations ago, this cause alone does not explain the unsatisfactory outcome. Considering the opportunities, students have not flocked to the study of science in the numbers predicted, nor has science modified the spirit and purport of all education in a degree commensurate with the claims made for it. The causes for this result are many and complex. One influential cause, the remedy for which most lies with scientific men themselves, is that science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.

The infinitely extensive character of natural facts and the universal character of the laws formulated about them is sometimes claimed to give science an advantage over literature; but viewed from the standpoint of education, this presumed superiority turns out a defect; that is to say, so long as we confine ourselves to the point of view of subject-matter. Just because the facts of nature are multitudinous, inexhaustible, they begin nowhere and end nowhere in particular, and hence are not, just as facts, the best material for the education of those whose lives are centred in quite local situations and whose careers are irretrievably partial and specific. If we turn from multiplicity of detail to general laws, we find, indeed, that the laws of science are universal, but we also find that for educational purposes their universality means abstractness and remoteness.

One of the most serious difficulties that confronts the educator who wants in good faith to do something worth while with the sciences is their number and the indefinite bulk of the material in each. At times it seems as if the educational availability of science were breaking down because of its own sheer mass. There is at once so much of science and so many sciences that educators oscillate, helpless, between arbitrary selection and teaching a little of everything. Science teaching has suffered because science has been so frequently presented just as so much ready-made knowledge, so much subject-matter of fact and law, rather than as the effective method of inquiry into any subject-matter.

We define science as systematised knowledge, but the definition is wholly ambiguous. Does it mean the body of facts, the subject-matter? Or does it mean the processes by which something fit to be called knowledge is brought into existence, and order introduced into the flux of experience? That science means both of these things will doubtless be the reply, and rightly; but in the order both of time and of importance, science as method precedes science as subject-matter. Systematised knowledge is science only because of the care and thoroughness with which it has been sought for, selected, and arranged. Only by pressing the courtesy of language beyond what is decent can we term such information as is acquired ready-made, without active experimenting and testing, science. The force of this assertion is not quite identical with the commonplace of scientific instruction that text-book and lecture are not enough—that the student must have laboratory exercises. A student may acquire laboratory methods as so much isolated and final stuff, just as he may so acquire material from a text-book. One's mental attitude is not necessarily changed just because he engages in certain physical manipulations and handles certain tools and materials. This problem of turning laboratory technique to intellectual account is even more pressing than that of utilisation of information derived from books. Almost every teacher has had drummed into him the inadequacy of mere book instruction, but the conscience of most is quite at peace if only pupils are put through some laboratory exercises. Is not this the path of experiment and induction by which science develops?

It must not be supposed that, in dwelling upon the relative defect and backwardness of science teaching, the intention is to deny its absolute achievements and improvements, but it must be pointed out that only to a comparatively slight extent has the teaching of science succeeded in protecting the so-called educated public against recrudescences of all sorts of corporate superstitions and silliness.

It is not to be expected that our schools should send forth their students equipped as judges of truth and falsity in specialised scientific matters; but that the great majority of those who leave school should have some idea of the kind of evidence required to substantiate given types of belief does not seem unreasonable. Nor is it absurd to expect that they should go forth with a lively interest in the ways in which knowledge is improved and a marked distaste for all conclusions reached in disharmony with the methods of scientific inquiry.

The future of our civilisation depends upon the widening spread and deepening hold of the scientific habit of mind, and the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit. Mankind, so far, has been ruled by things and by words, not by thought, for until the last few moments of history humanity has not been in possession of the conditions of secure and effective thinking. Without ignoring in the least the consolation that has come to men from their literary education, it is not too much to say that only the gradual replacing of a literary by a scientific education can assure to man the progressive amelioration of his lot. Unless we master things we shall continue to be mastered by them; the magic that words cast upon things may indeed disguise our subjection or render us less dissatisfied with it, but, after all, science, not words, casts the only compelling spell upon things.

The modern warship seems symbolic of the present position of science in life and education. The warship could not exist were it not for science—mathematics, mechanics, chemistry, electricity supply the technique of its construction and management; but the aims, the ideals in the service of which this marvellous technique is displayed, are survivals of a pre-scientific age, that is, of barbarism. Science has as yet had next to nothing to do with forming the social and moral ideals for the sake of which she is used. Even where science has received its most attentive recognition, it has remained a servant of ends imposed from alien traditions. If ever we are to be governed by intelligence, not by things and by words, science must have something to say about *what* we do, and not merely about *how* we may do it most easily and economically; and if this consummation is achieved, the transformation must occur through education, by bringing home to men's habitual inclination and attitude the significance of genuine knowledge and the full import of the conditions requisite for its attainment. Actively to participate in the making of knowledge is the highest prerogative of man and the only warrant of his freedom. When our schools truly become laboratories of knowledge-making, not mills fitted out with information-hoppers, there will no longer be need to discuss the place of science in education.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—Committees of members and friends of the University have procured contributions amounting to some 1500*l.* for the purpose of commemorating the services of Dr. John Cleland, regius professor of anatomy from 1877 to 1909, and Dr. William Jack, professor of mathematics from 1879 to 1909, who retired last year. It has been decided to present to the University a portrait of Dr. Cleland, painted by Sir George Reid, with a replica for Mrs. Cleland; and a portrait of Dr. Jack, painted by Sir James Guthrie, and also a prize, to be awarded at intervals, for the best thesis on a mathematical subject approved for the degree of Doctor of Science during the preceding period.

The University Court and Senate have had under consideration a proposal, emanating from the general council of graduates, for the establishment within the University of an order of independent lecturers, analogous to *privat-docenten*, who should give courses of lectures qualifying for graduation, and duplicating those already given by the regular professors and lecturers. The new lecturers were to be provided with class-room accommodation, and were to depend for their remuneration on the amount of fees received from students attending their classes. After a prolonged discussion, in which the Senate expressed the opinion that the proposal was not likely to contribute to educational efficiency, and the finance committee that it would seriously disarrange the University funds, the Court decided that effect could not be given to the scheme under the existing constitution of the University.

The University Court has sanctioned the establishment of a new course of instruction in chemistry, including metallurgical chemistry, for students of engineering. The course will be given by Dr. Cecil H. Desch, and will extend over the first two terms of the session. The ordinary course by Prof. Ferguson will be attended by students of arts, medicine, and pure science. Dr. Desch announces a course in metallography during the summer session.

THE Civil Service Estimates in class iv. (education, science, and art), just issued as a White Paper, show a net increase for 1910–11 of 697,718*l.* over the figures for 1909–10. The total estimates of 18,651,483*l.* for the ensuing year include the following:—Board of Education, 14,064,677*l.*, increase 417,663*l.*; British Museum, 175,895*l.*, decrease 3333*l.*; scientific investigation, &c., 74,228*l.*, increase 9764*l.*; universities and colleges, Great Britain, and intermediate education, Wales, 218,100*l.*, increase 700*l.* Scotland: public education, 2,253,725*l.*, increase 106,434*l.*; Ireland: public education, 1,656,901*l.*, increase 34,980*l.*; endowed school commissioners, 925*l.*, increase 5*l.*; universities and colleges, 168,080*l.*, increase 139,930*l.*; Queen's Colleges, nil (last year 4700*l.*).

A DEPUTATION from the Trade Union Congress waited upon Mr. Runciman, President of the Board of Education, on March 17 to urge, among other matters, technical training in day-time classes, the raising of the school age, entirely free secondary education, and the appointment of a Royal Commission to inquire into the misappropriation of educational endowments. In replying, Mr. Runciman said he hopes that by next Session a Bill will be introduced which will deal partly with the raising of school age and partly with the question of day technical classes. If day technical classes are to be of much use, there must be pressure brought to bear on employers. All educationists desire to see the school age raised. Children who leave school at thirteen or fourteen know practically nothing about arithmetic or writing with ease. This deplorable state of things can be remedied in two ways, by raising the school age and by bringing the technical classes nearer to them. Trade unionists, he said, can do as much towards the advancement of education as Parliament can. Dealing with free places in secondary schools, Mr. Runciman said that, taking the whole of the secondary schools of this country in 1907–8, there were 2 per cent. more than the 25 per cent. standard, while in 1909–10 31 per cent. of the total places in the secondary schools were free places.